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FINAL REPORT

PROTO-TYPE

HEAVY RESCUE-FIRE FIGHTING VEHICLE

FOR

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PROTOTYPE
HEAVY RESCUE/FIRE FIGHTING VEHICLE

FINAL REPORT

FEMA CONTRACT NO. 01-78-C-0269

FEMA WORK UNIT NO. 2511-C
DISTRIBUTION: FEMA 2500 DISTRIBUTION LIST
SEPTEMBER 1980

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for

Federal Emergency Management Agency
Washington, D.C. 20472

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4/10/84

HEAVY RESCUE/FIRE FIGHTING VEHICLE
FINAL REPORT

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STATE OF CALIFORNIA
OFFICE OF EMERGENCY SERVICES
FIRE AND RESCUE DIVISION

CONTRACT NO. DCPA-01-78-C-0269
HEAVY RESCUE/FIRE FIGHTING VEHICLE

F I N A L R E P O R T

ABSTRACT:

The end result product of this contract is a non-complex, dual-function vehicle. It combines heavy rescue and fire fighting capability into a single unit.

Throughout this project, two factors had paramount importance -- ease of operation, and simplicity of construction.

OBJECTIVES: were to:

- Design, construct, and equip a prototype vehicle with heavy rescue and/or fire fighting capabilities (prototype includes both capabilities);
- Research and define the most effective payload requirements;
- Employ contemporary engineering practices through all phases of construction, allowing for total or partial buildup by "locals"; and
- Test and evaluate vehicle.

METHODS:

- Procurement Phase - All expenditures for materials, equipment and other related items are governed by (California State) standard procedures.
- Construction Phase - A combination of on-site construction (California OES Fire Shop) and sublet construction. The rationale for subletting portions of construction would be defined as follows:
 1. Expedite project completion.
 2. On-site shop facility not equipped for some construction operations.
 3. Cost-effectiveness via low bid process.
- Discussion of Research Accomplished - The California OES Fire and Rescue Division staff analyzed the contemporary needs for the Fire and Rescue Service at large. After due determination, certain areas of operational deficiency were identified. Most frequently,

deficiencies reflected a shortage of manpower and inadequate rescue tools and appliances for rapid response to life-saving rescue operations.

Other deficiencies noted relate to the lack of standardized heavy rescue training and remedial training.

Extensive research was accomplished in the area of payload hardware, and we feel the diverse payload of this vehicle is unique.

DATA:

● Basic Vehicle Chassis

Ford, 1978 year model, Mfg. model C8000.

Configuration: Cabover engine.

Engine: Diesel, 200 HP, natural aspiration.

Wheel Base: 157 inches (modified).

Transmission: Manual, 5 speeds forward.

Front Axle: 16000# steerable drive (retrofit).

Rear Axle: 22000# single reduction, two speed.

Transfer Case: Two speed (retrofit).

Rims: 8.0 inch, 10 hole, disc type.

Tires: 1100 x 20 inch, 14 ply.

Frame: Factory reinforced.

● Body

Commercial construction, utility type, ten ft. length.

Full compartmentation.

● Module

OES design; unique features include 50-gallon hydraulic oil reservoir, transverse hose bed, foam eductor system, battery compartment, brass fittings and misc. hose adapters compartment.

● Winch System

Front: 8000# straight pull, electric.

Rear: 20000# straight pull, hydraulic.

- Fire Pump

1000 GPM, single stage, centrifugal type. Skid-mounted and powered with a 460 cubic inch gasoline engine.

CONCLUSIONS AND RECOMMENDATIONS:

Based on testing and field evaluation to date, the following conclusions are relevant:

- Dual purpose vehicle concept is valid where applicable.
- The Fire and Rescue Service is supportive of the extremely functional capabilities provided by this vehicle.
- The economic approach to construction is desirable, based on current budget constraints.

Our recommendations can be summarized by stating we are enthusiastic and extremely pleased with the end result product. As of this writing, we are vigorously pursuing all avenues available for funding additional dual purpose vehicles. Our strong recommendation would be a match funding program provided for nationwide application of this concept.

DETAILED VEHICLE PAYLOAD
HEAVY RESCUE/FIRE FIGHTING VEHICLE

WATER TANK: 560 U.S. GALLONS

FOAM TANK: 30 U.S. GALLONS

HYDRAULIC RESERVOIR: 50 U.S. GALLONS

DIESEL FUEL TANK: 50 U.S. GALLONS (MAIN ENGINE)

GASOLINE TANK: 30 U.S. GALLONS (PUMP ENGINE)

FRONT WINCH: 8000# ELECTRIC, TWO SPEED

REAR WINCH: 20000# HYDRAULIC, TWO SPEED.

FOAM SYSTEM: (PRE-PLUMBED) TWO 1 $\frac{1}{2}$ " DISCHARGE LINES.

HOSE LOAD: 5" (QUICK-CONNECT COUPLINGS), 300 FT.

3" (LIGHTWEIGHT, NH COUPLINGS), 150 FT.

2 $\frac{1}{2}$ " (DOUBLE JACKET, NH COUPLINGS), 300 FT.

2" (LIGHTWEIGHT, COUPLED 1 $\frac{1}{2}$ " NH), 450 FT.

HARD SUCTION HOSE: 20 FT. (2 SECTIONS) 5" NH COUPLINGS

SOFT SUCTION HOSE: 12 FT. x 5" (NH COUPLINGS)

12 FT. x 2 $\frac{1}{2}$ " (NH COUPLINGS) PRE-CONNECTED

LADDERS: 20 FT. TWO SECTION

12 FT. ROOF

8 FT. ATTIC

"A" FRAME: REAR, REMOVABLE, RATED 6000#, STRAIGHT LIFT.

CANTILEVER BEAM: 10FT. 2 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ " x $\frac{1}{4}$ " SQUARE TUBING*

6 FT. 2 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ " x $\frac{1}{4}$ " SQUARE TUBING*

* TENSILE 58,000 PSI, YIELD 46,000PSI, BRINELL HARDNESS B SCALED 121.

AIR HAMMER RESCUE KIT: "SUPERIOR" NO. 301, LOW PRESSURE

PRY AXE: "PARTNER" #500

SUPER RAMBAR: "PARTNER" #650, HIGH ALLOY STEEL, HEAT TREATED

Hooligan Tool: "PARTNER" #601

BREATHING APPARATUS: (3) EA. PRESSURE DEMAND TYPE "SURVIVAIR"
#9838-22*

AIR CYLINDERS: (9) EA. 30-MINUTE, "SURVIVAIR" #9151-45*

*NIOSH APPROVED.

NOZZLES: (2) EA. 2 $\frac{1}{2}$ " S/S W/SHUTOFF AKRON

(1) EA. 2 $\frac{1}{2}$ " TURBOJET #1731 AKRON*

(2) EA. 1 $\frac{1}{2}$ " TURBOJET #1715 AKRON**

* 120-150-200-250 GPM ** 30-60-95-125 GPM

(2) EA. 1 $\frac{1}{2}$ " FOG COMBINATION AKRON INDUSTRIAL

RESCUE AIR BAG KIT: "PARTNER" SYSTEM #161 INCLUDES:

- (1) EA. 40 TON BAG
- (1) EA. 30 TON BAG
- (1) EA. 25 TON BAG
- (2) EA. 18 TON BAG
- (1) EA. 14 TON BAG
- (1) EA. 9 TON BAG
- (1) EA. 7 TON BAG

"HURST" POWER RESCUE TOOL (JAWS OF LIFE) MODEL 32-A, INCLUDES:

- POWER RESCUE TOOL
- SPREADING JAWS
- CUTTING JAWS
- POWER SHEARS
- POWER UNIT
- HIGH PRESSURE HOSE
- CHAIN, HOOKS, SHACKLES

"HURST" RESCUE CUTTER, MODEL 362-R003, "150" BLADE. 5000 PSI, HIGH PRESSURE HOSE.

GENERATOR: 3300 WATT, 110/220 VOLT, 30 AMP "McCULLOCH" RA-330, PORTABLE

CHAIN SAW: 16" BAR "HOMELITE" SUPER XL

RESCUE SAW: PARTNER K-1200

RESCUE SAW: PARTNER K-65

CUTTING TORCH OUTFIT: "VICTOR" MODEL 315, 50 FT. HOSE, #80 OXYGEN CYLINDER, #3 ACETYLENE CYLINDER

FIRE EXTINGUISHERS: (1) EA. 30# CLASS "D" FIRES, ANSUL MET-L-X MODEL 7003

(1) EA. 30# DRY POWDER, CLASS A B & C FIRES, ANSUL MODEL 14354

(1) EA. 2 $\frac{1}{2}$ GAL. WATER

(1) EA.CO₂

(1) EA. DRY POWDER 2 $\frac{1}{2}$ # (IN CAB)

GRIPHOIST: TU-17 RESCUE KIT, MANUAL HOIST 60 FT. 5/16 WIREROPE, OSHA APPROVED FOR PERSONNEL LIFTING AND LOWERING.

RESUSCITATOR: "ROBERTSHAW" MODEL NO. 900-002-175-03 WITH "D" SIZE OXYGEN CYLINDER.

TRAUMA KIT: EMERGENCY MEDICAL TECHNICIAN I LEVEL "LIFE ASSIST" CAT. NO. LA-394

STRETCHER: RESCUE BASKET "DYNA MED" #A11106 ABS PLASTIC W/H.D. ALUMINUM FRAME, HIGH VISIBILITY ORANGE COLOR. COMPLETE WITH STRAPS AND FOUR-POINT BRIDLE.

SPINE BOARD: (1) EA. LONG, W/STRAPS "DYNA MED"
(1) EA. SHORT, W/STRAPS "DYNA MED"

ROPE: 600 FT. X 1 $\frac{1}{2}$ " NYLON "TUBBS" GOLDLON CODE 330
225 FT. X 3/4" NYLON "TUBBS"

CHAIN: 25 FT. SERIES 8 $\frac{1}{2}$ " LINK W/GRAB HOOKS.
15 FT. SERIES 8 3/8" LINK W/GRAB HOOKS.

HYDRAULIC JACKS: (4) EA. 20-TON CAPACITY LOW PROFILE, VIKING MODEL 77

PORTA POWER: 10-TON "HEIN-WARNER" RESCUE JAC-KIT, PUSH-PULL TYPE

JACK, MECHANICAL: (2) EA. HIGH LIFT TYPE.

RESCUE KIT: K-BAR-T FORCIBLE ENTRY AND EXTRICATION TOOL. "ZIAMATIC" CORP. MODEL K-B-T.

SMOKE EJECTOR: "SUPER VAC" MODEL P-164 SE. 115/230 VOLT, 60 CYCLE, EXPLOSION PROOF, 5200 CFM.

CHEMICAL SUIT: (3) EA. "CHEM-PRO" MODEL ECP-2000, DESIGNED WITH B/A POUCH AND INTEGRAL AIR DISTRIBUTION SYSTEM. CONSTRUCTED W/12 OZ. BUTYL RUBBER ON NYLON FABRIC.

COMBUSTIBLE GAS INDICATOR: "J-W SNIFFER" ASPIRATOR BULB W/ALUMINUM AND FIBERGLASS PROBE.

BLANKETS: (12) EA. 4# HEATHER

CANVAS TARP: (4) EA. 10 FT. X 12 FT.

BUCKET: (1) EA. 14 QT. (1) EA. 20 QT.

GLOVES: NEOPRENE W/GAUNTLET (3) PR. (ACID TYPE).

LINEMAN'S HIGH VOLTAGE (15,000 VOLTS MIN) - ONE PAIR.

HARD HAT: (3) EA. #352, OSHA APPROVED, DAYGLO ORANGE.

GRINDING SHIELD: (3) EA. #237/ES-596 CLEAR

RESPIRATOR: (3) EA. DUST FILTERING.

LINE GUN: "BRIDGER" DELUXE FIRE DEPARTMENT SHOULDER LINE GUN KIT W/310# AND 70# TEST LINE #7094.

PUMP, PORTABLE: "WATEROUS" FLOTO-PUMP, STANDARD MODEL, 140 GPM @ 108 PSI, PORTABLE, ONE CYLINDER, TWO CYCLE GASOLINE ENGINE.

SAFETY GASOLINE CAN: (5) GALLON "EAGEL" TYPE II

BOLT CUTTER: (1) EA. 36" (1) EA. 18"

WIRE CUTTER: HIGH VOLTAGE

BURN PACK: #BP 200 MINI BURN PAC

SEARCH AND RESCUE BELT: PERSONNEL, #AR-30

GENERAL PURPOSE BELT: PERSONNEL, #AB-340

ATLAS BELT: PERSONNEL, #AB-246R

TANK AND MANHOLE HARNESS: PERSONNEL, "KLEIN" #5450

LANYARD: NYLON, 6 FT. W/HOOKS, #ARL 510

CRASH AXE: AIRCRAFT TYPE #60225

PIKE POLE: 10 FT., HIGH VOLTAGE FIBERGLASS HANDLE, RATED 20,000 VOLTS

LIGHTS: (4) EA. PORTABLE, 500 WATT A.C.

(4) EA. FIXED MOUNTED (VEHICLE) QUARTZ, 500 WATT

ELECTRICAL CORD: (1) EA. REEL W/150 FT. 12-3 FLEXIBLE CORD, 600 VOLT, NEOPRENE JACKET.

(2) LENGTH 50 FT. EA. 14-3 FLEX CORD (SO)

(1) LENGTH 25 FT. 14-3 FLEX CORD (SO)

ELECTRICAL JUNCTION BLOCK: (3) OUTLET "HUBBELL" (3) WIRE, "TWIST LOCK" 15 AMP. MALE: 4720-C, FEMALE 4729-C, BOOT MALE 6023, FEMALE 6024. (ALL CONNECTIONS ARE WATER-RESISTANT)

HAY HOOKS: (2) EA.

SHOVEL: (1) EA. LHRP; (1) EA. LHSP

(1) EA. SHRP; (1) EA. SHSP

SKIL SAW: HEAVY DUTY (1) EA.

TOOL KIT: MECHANICS HAND TOOLS

HAMMERS: SLEDGE, 2#, 4#, 8#, 16#

PRY BAR: VARIOUS SIZES

NAIL BAR: VARIOUS SIZES

FIRE BLANKET: PERSONNEL TYPE, (3) EA.

CRIBBING: 10 CUBIC FEET

ADAPTERS AND FITTINGS:

HYDRANT ADAPTERS - 5" X 4 $\frac{1}{2}$ "; 5" X 4"; 5" X 2 $\frac{1}{2}$ "

ADAPTERS - 2 $\frac{1}{2}$ " F X 1 $\frac{1}{2}$ " M; 1 $\frac{1}{2}$ " NH-IP, IP-NH, PC-NH, NH-PC

COUPLINGS - 2 $\frac{1}{2}$ " DBL FEM (2) EA. 1 $\frac{1}{2}$ " DBL FEM
2 $\frac{1}{2}$ " DBL MALE (2) EA. 1 $\frac{1}{2}$ " DBL MALE

GATED WYE: (1) EA. 2 $\frac{1}{2}$ X 2 $\frac{1}{2}$ X 2 $\frac{1}{2}$; (1) EA. 2 $\frac{1}{2}$ X 1 $\frac{1}{2}$ X 1 $\frac{1}{2}$

MECHANICAL AXE: w/extension, rated 15,000 volts.

SUCTION STRAINER: 5: NH (basket type).

ATTACHMENT 1

INCREASER: 1" IPF X 1 $\frac{1}{2}$ " NHM

SIAMESE: (1) EA. 2 $\frac{1}{2}$ " X 2 $\frac{1}{2}$ " X 2 $\frac{1}{2}$ "

HYDRANT WRENCH: (2) EA.

HOSE CLAMP: (1) EA.

HOSE & LADDER STRAP: (4) EA.

HOSE SPANNER: (4) EA.

SUCTION HOSE SPANNER: (1) EA.

HAND LANTERN: (2) EA. 6 VOLT

HEAD LAMP: FORESTER TYPE (3) EA. "D" CELL.

BROOM: PUSH TYPE, ASPHALT

BLOCK AND TACKLE: THREE PART, 3/4" LINE

AXE: SINGLE BIT (3) EA.

PICK HEAD (1) EA.

PUNCH: SPRING LOADED (2) EA.

SEAT BELT CUTTER: (2) EA.

HAMMER: ROCK (1) EA.

GOGGLES: (3) PAIR, CLEAR; (1) PAIR CUTTING;

GLOVES: (1) PAIR WELDING

SNATCH BLOCK: 4" X 5/8" W/HOOK (MOUSED)

P.A. SYSTEM: "UNITROL" MODEL 800

DESCENT CONTROL: (2) EA. F.D. MODEL

CARRIBEANERS: VARIOUS "SMC"

POLE CLIMBING SPURS: (1) PAIR

TAILBOARD & LADDER SAFETY BELT: (2) EA.

FIRST AID KIT: 24-UNIT (CAB MOUNTED)

SAFETY BLANKET: 40" X 80", USED FOR VICTIM PROTECTION AGAINST HEAT,
SPARKS FROM CUTTING, ETC.

RADIO: 8-CHANNEL, MOTOROLA MICOR, CROSS BAND

D E S I G N D E S C R I P T I O N

GENERAL

The design of this vehicle is based on a modular concept of reusable major components; i.e., "Utility" type body, skid-mounted fire pump, water tank, etc. Employing the modular concept affords the purchaser a number of advantages and/or options. Several of the options are cited below:

1. Water tank size; i.e., capacity
2. Fire pump size; i.e. GPM
3. Transverse hose bed feature
4. All wheel drive feature

Advantages could be noted as follows:

1. Local area construction for non-custom body.
2. Reusable components.
3. Participation in all or portions of the assembly phase; i.e., installation of skid-mounted fire pump, mounting the body, etc.

DETAILS

Front Body Module:

The front body module is located to the rear of the vehicle cab and on the forward side of the skid-mounted fire pump. The module is saddle-mounted across the main frame of the vehicle.

Basic dimensions of the module:

Width	96"
Length	32"
Height	66"

Design of the module provides the following features:

- Compartment for two 8D8, 200 ampere hour, 12 volt batteries. Batteries are mounted on a slide-out tray for ease of service and inspection.
- Compartment for miscellaneous adapters and fittings. (Basic fire pumper complement). All items are peg-mounted and a slide-out tray is employed for ready access of all items.
- Foam system bypass eductor is (pre-piped) mounted behind a removable control panel on the driver's side of the module. The panel is the termination point for the following remote controls:

Foam Eductor valve
Foam Flush valve
Foam Tank valve
Water Inlet valve (for foam eductor)
Foam Metering Dial
Transverse Hose Lines (pre-connected lines)
(2) 1 $\frac{1}{2}$ " valves; (1) 2 $\frac{1}{2}$ " valve

The interior of the module houses necessary piping and valves for support of the foam system and transverse hose lines. Also, a 50-gallon hydraulic oil reservoir necessary for rear winch and tool (hydraulic) circuit operations (hydraulic winch and hydraulic tool circuit operations are covered later in this report) is mounted within the module.

The upper level of the module accommodates two 150 ft. pre-connected 1½" hose lines and one 150 ft. pre-connected 2½" hose line. The 1½" lines are connected to "Chicksan" water swivels, permitting charged line operation from either driver's side or passenger's side of vehicle. The pre-connected 2½" line is directional to the passenger's side of the vehicle.

Additional compartmentation is provided for equipment storage and fuel tank fill access. Removable deck plates, and inspection covers are incorporated for ease of repair and maintenance to all components.

Skid-Mounted Fire Pump:

The skid-mounted fire pump is located to the rear of the front body module and on the forward side of the main body. The pump and drive engine are contained on a sub-frame which is mounted at a right angle to the vehicle main frame.

Fire Pump and Drive Engine Data:

Pump -

Make: Hale
Model: FB-100-460
Type: Single Stage Centrifugal
Capacity: 1000 gallons per minute from a 10-foot lift.
Suction Inlet: Male national hose thread (NH), six inch (6").
Adapter: Suction Inlet, 6" NH Female X 5" NH Male.
Cap: Suction, 5" NH Long Handle.
Suction Inlet: 2½" Gated with NH Female Swivel Inlet.
Discharge Manifold: Three 2½" Hale BL discharge valves with discharge caps.
Pump Shaft: Heat treated stainless steel for corrosion resistance and high strength. Drive end splined for maximum strength.
Impeller: Bronze enclosed type.
Clearance Rings: Two renewable bronze for hydraulic balance.
Seal: Mechanical type, requiring no adjustment.
Primer: "Hale" electric w/"T" handle control.
Pressure Regulator: "Hale" Engine Master pressure governor.
Pump and drive engine are close coupled. Pump is bolted direct to engine housing.

Engine -

Make: Ford
Model: 460
Type: Galoline "V" 8 cylinder.
CID: 460
Cooling System: Heavy duty for industrial engine application.

The pumping unit as installed on this vehicle directs pump, discharge gates, and control panel toward the driver's side of the vehicle. The fuel tank for the pump drive engine is frame (vehicle) mounted on the passenger side, directly below the pump engine radiator, and has a removable step plate cover.

Access for service, repairs and maintenance is via removable panel at the front of the main body or a hinged inspection door on the top side of the drive engine. If major engine maintenance is required, the complete pump and engine unit is removable by unbolting sub-frame, disconnecting piping, electrical, and fuel lines, then lifting complete unit straight up via hoist, etc.

NOTE: The front body module and main body remain in place if it becomes necessary to remove the pumping unit.

Main Body:

The main body design can best be described as an oversized "Utility or "Service" body style without a bed area.

Dimensions:

Length	120 inches
Width	95 inches
Height	68 inches

Material - 12-gauge, cold roll steel used for all body construction, with the exception of compartment doors which are 14-gauge cold roll steel.

Method of Construction - Shear, press break and form all materials to required size based on compartmentation requirements, etc. All sheet metal components related to body construction are welded into position with the exception of four sub-frame cross channels. This type of body construction would be considered "Unitized." This method of construction will generally have greater body strength with less body weight involved, thus payload delivery can be expanded.

Body Compartments - Driver's side and passenger's side of the body have identical compartmentation. With the exception of the forward compartment, all other side compartments have a depth of 24 inches. The forward compartment is a full body height and full body width type, stepping over the vehicle frame. A removable deck plate is provided in the center section.

Sub-Frame - The sub-frame as mentioned earlier, consists of four cross channels (4" web 2" flange) welded to the body components. With the body in position on the vehicle, two sub-frame members (positioned at a right angle to the vehicle frame) run full width (body) and lay 25" forward and 25" aft of the center line of the rear axle. The other two sub-frame members are of the "rack" or "saddle" type, also positioned at a right angle to the vehicle frame. One is located at the forward-most body position; the other is inward from the rear (20 inches).

Body Mounting - The body is mounted to the vehicle main frame and employs two methods. One method is the conventional "U" bolt over the two center sub-frame members and continuing downward below the vehicle main frame, then end plated and retained with 5/8 inch torque lock hex nuts. The second provision for securing the body was accomplished by welding angle brackets on the "saddle" type sub-frame members (4 points) and terminating the anchor at the vehicle frame rail (not flange) via 5/8 inch drill holes (reamed) and retained with grade No. 8 bolts and torque lock nuts.

Compartments, Other -

- **Body Rear.** A removable, double-door compartment constructed from 14-gauge cold roll steel is in position between the two main body sections, rising to the height of the water tank top. This compartment measures 47" width, 34" height, and 16" depth. In position, it provides ready access to the three self-contained breathing apparatus and spare air cylinders.
- **Suction Hose Compartment.** Driver's side, top of main body. This compartment is 120 inches in length, 24 inches in width, and 8 inches in height, blind front and drop down compartment door (rear) are incorporated. This compartment houses two lengths of 5" hard suction hose, one folding ladder and one pike pole.
- **Elevating Ladder Compartment.** The elevating ladder compartment is located on the passenger's side, top of main body. Dimensional redundancy between this compartment and the suction hose compartment prevails. To aid off-loading and reload of ladders and "A" frame elements, this compartment is designed to elevate 16 inches at the forward-most point. A full width hinge is located at the rear-most point, thus providing a suitable pivot point when raising and lowering this compartment. Controls are remoted to the main body, rear, passenger's side. The elevating mechanism consists of a hydraulic ram, 12-volt DC motor with an integral hydraulic oil reservoir, mounted within the forward-most main body compartment, passenger's side.

Water Tank:

The water tank is located in the bed area of the main body and is rigid-mounted to three of the four main body sub-frame members.

Dimensions:

Length: 72 inches
Width: 45 inches
Height: 40 inches

Material: 10-gauge hot roll sheet steel.

The basic design is flat bottom, rectangular shape with a loaded capacity of 560 U.S. Gallons. In position, the tank is mounted to provide a one-inch forward slope toward the sump.

- Tank supports - Three full-width angle iron cross members, welded to tank bottom. In position, tank supports index with the three rearward main body sub-frame members, thus enabling a flange-type mount (tank to body).
- Tank Cover - Single sheet (10 Ga. H/R) with fill pipe and baffle welded to cover. Dimension: 41 inches x 68 inches.
- Baffle - Diamond-shape and welded to tank cover. Baffle dimensions:

Length (point to point): 60 inches
Width (point to point): 32 inches
Depth (downward from cover): 37 inches
- Sump - One sump is provided on the tank bottom located on the driver's side, forward end. Sump dimensions:

Length: 10 inches
Width: 8 inches
Depth: 15 inches

Three features are incorporated into the sump design:

Provision for suction connection (to fire pump);
Clean out plug (bottom); and
Swirl baffle and screen.

- Tank Filler Pipe - Welded to tank cover. Five-inch ID (pipe), 12-inch rise above tank cover and 10-inch below cover. Located on the driver's side of the tank cover, forward end. Features are as follows:

Force-fit cap with pull handle;
Water surge flapper;
Vent System; Connection for overflow line;
Connection for filling tank from pressure side of pump. (The connection inlet is above full tank waterline, thus providing an air gap. The air gap between inlet and full tank waterline prevents tank damage from pressurization.);

Seams - all seams are full-weld, inside and outside;
Side Sheet Design - permits all tank cover securing bolts to remain outside of water line;
End Sheet Design - redundant to side sheet, as it applies to cover bolting.

- General - Interior of the tank employs four surge or swirl fins. The fins are welded in a vertical position at the (vertical) center line of end and side sheets. (Bottom of fin is $3\frac{1}{2}$ " from tank bottom and extends upward 29 inches; fin is 3 inches in width.)

Prior to the application of interior tank coating, all surfaces were sand-blasted.

Tank is secured in position with six 5/8" grade No. 8 bolts with torque lock hex nuts (2 bolts per tank support extending through sub-frame members of main body). If required, the complete tank is removable from the vehicle without disruption of any major component.

All tank cover bolts are 5/16 national course thread with self-locking hex nuts. Bolts are placed at not less than 5-inch centers. Cover gasket is $1\frac{1}{2}$ " x 1/8" cork. Gasket is glued to the cover, and face of gasket contacting tank is greased.

Front Winch:

In order to mount this winch, the following modifications to the vehicle were necessary:

- Extend the vehicle main frame (forward). Considerations involved:
 - Maintain structural integrity engineered by the chassis OEM.
 - Comparable frame channel material for the extension (section modulus/resisting bending moment, etc.).
 - Calculation of simple stress loading.

A step-down frame extension was determined to be the most advantageous and expedient method for achieving the desired end result. Details - A dual reinforced frame channel (8" rail, 3" flange) extending 11 inches forward and 8 inches rearward from the vehicle frame forward termination point, was positioned flange-to-flange (parallel to the vehicle frame). Existing drill holes in the bottom flange of the vehicle main frame permitted indexing drill holes in the top flange of the extension members, thus permitting the use of two Grade No. 8 x 1/2 inch diameter securing bolts on each side.

To achieve the required integrity for shear, tensile and compression loading, fishplating each side was required. Two fishplates were secured in an overlap position (one each on the outboard side of each frame rail) between the flange-to-flange contact area of the vehicle frame and frame extension. Fishplates conform to the step-down application and bolt through reamed drill holes in all necessary components. Plate material is 3/8", high carbon stock. All securing bolts are Grade No. 8 with torque lock hex nuts. For lateral strength the following components are in position: 2 $\frac{1}{2}$ " x 2 $\frac{1}{2}$ " full width angle iron cross member (rail-to-rail inside); sub-frame of winch also rail-to-rail inside frame channel and the full width front bumper.

Data:

Winch, Make - Ramsey
Model - DC2-246
Type - Two speed, reversible
Style - Low mount
Power - 12 volt D.C.
Control - Remote type
Rated - 8000# straight line pull
Line Speed - High 32 ft. per min.
Low 19 ft. per min.
Ratios - 46:1 Low
30:1 High

Self-locking worm and gear, and free-spooling are incorporated features. Roller guide is provided, Ramsey No. 274007.

Cable - 150 ft. x 5/16 inch, Aircraft type.

Rear Winch:

This winch is located at the rearmost point of the vehicle chassis. The winch is mounted to an OEM sub-frame. The sub-frame was modified for additional strength and convenience of installation. In position on the vehicle, the winch and sub-frame are mounted between the main frame rails of the vehicle and serve as a crossmember at the end of the vehicle main frame. All securing has been accomplished via reamed drill holes, using Grade No. 8 bolts and torque lock hex nuts.

Data:

Winch, Make - Braden
Model - AMU7-16-F
Type - Two speed, reversible
Style - Low mount
Power - Hydraulic motor
Control - Lever, deadman (spring loaded).
Rated - 20,000# straight line pull.
Line Speed - High 42 ft. per min.
Low 20 ft. per min.

This winch is equipped with an oil-cooled, fully adjustable, automatic safety brake which stops and holds the load in place when hoisting operation requires it. Free-spooling feature is incorporated and cable roller guide is provided. Cable - 200 ft. x 5/8" (6x37 classification).

Hydraulic System:

As previously noted, the rear winch is powered by a hydraulic motor. The following is a brief description of this system and options available.

Hydraulic oil is supplied from a 50 U.S. gallon reservoir (housed within the front body module) direct to a dual impeller hydraulic pump. The hydraulic pump is operated by a transmission-mounted power take off (PTO) unit. As installed, the PTO and the pump are connected with a universal shaft assembly. PTO is cable-controlled from the driver's position in the cab. Hydraulic oil is piped from each of the pressure outlets of the hydraulic pump as follows:

- 11 gpm to the winch directional control valve. (Directional control valve permits hydraulic oil to enter the winch hydraulic motor.)
- 16 gpm is discharged to a shuttle valve. Shuttle valve permits routing of all hydraulic pump discharge to the winch motor or selective routing to a hydraulic tool circuit, or bypass routing back to reservoir.

As with any hydraulic system, all necessary relief valves, check valves, gauges, return line manifold, and filtration system have been incorporated. The complete system has the capability of operating the rear winch and simultaneously operating three 5 gpm hydraulic tools.

Data:

Hydraulic Motor - Char-Lynn #104-1004
Hydraulic Motor Adapter - Braden #61482
Power Take Off (PTO) - #42LNG
Hydraulic Pump - Dennison #T5CC-014-008-1-R
Relief Valve - Dennison #R4V-03-515-10-A5
Directional Control Valve - "Brand" #DC75-0-4-L-D
Shuttle Valve - "Brand" #MS75
Check Valve - Rexroth #S15-A 3.0/5
Filter & Indicator - Schroeder #LF1-1K10-P-D
Gauge - 0-3000 PSI "UCC"
Flow Control Valve - "Brand" MS 75
Quick Connectors - Snaptite (male/female)

"A" Frame and Related Components:

In order to utilize the rear winch for upward hoisting operations, it was necessary to design and fabricate an "A" frame (boom) assembly suitable for application to the rescue/fire vehicle prototype.

Considerations prior to construction of the "A" frame are as follows:

- Maximum safe working load
- Time required for set up (based on 2 or 3 man crew)
- Storage factor when not in use
- Weight factor
- Cost factor
- Simplicity of construction and operation

Details:

Two tubular steel legs form the basic "A" frame. A pin-in-stub was designed and fabricated to accomplish the following:

- Retain each "A" frame leg in position at the top
- Provide a connection to the jib
- Suspend a tailboard type snatch block with sheave

The bottom end of each "A" frame leg is reinforced, slotted and drilled to facilitate attachment to the vehicle. To provide a suitable point on the vehicle to attach the "A" frame legs, it was determined that the vehicle main frame would be reinforced at the rear with fishplate positioned on the outboard side of each frame rail, secured via reamed drill holes and Grade No. 8 bolts with torque lock hex nuts. Fishplate is designed to extend beyond the main frame at top with a male pin connection exposed at each side. The lower portion of the fishplate accommodates pin on towing shackles. Elevation of the "A" frame is maintained via chain connection to a telescoping jib.

The jib is constructed from square tubing stock and employs a pin connection to the gantry. In the closed position, the jib is held firm by a support saddle and retaining pin. The gantry is designed to support all simple stress factors transmitted from the load bearing point; i.e., "A" frame, jib to gantry. In position, the gantry is flange mounted to a sub frame. The sub frame is secured to the main vehicle frame rails via reamed drill holes and Grade No. 8 bolts with torque lock hex nuts. Constructed from square tubing, each leg of the gantry extends upward from the sub frame mounting, attaining a top clearance of all body components. The vertical legs of the gantry are interconnected by one horizontal cross-member, which is welded in position. One brace is connected at the bottom, center of the cross-member and extends downward at 20° and is secured to the gantry sub frame.

Rear Stabilizers:

To prevent overloading of undercarriage components and rear tires during hoisting operations, stabilizers (drop jacks) have been incorporated as a design feature.

Details:

In position, the stabilizers are mounted vertically to the fishplate used in support of the "A" frame. One each on the outboard side of the main frame at the rear. The stabilizers are shop made and the basic design is as follows: Square tubing is welded to fishplating (mentioned above) and serves as the load bearing area and vertical guide for the stabilizer leg. Stabilizer legs are constructed from square tubing that telescopes within the guide tubing. Within each leg there is an "Acme" screw thread nut welded in position at the bottom and a mating jack screw. Indexing drill holes are provided for case hardened pins (one per leg) which retain the legs in the retracted position or support the load in the extended position. Each jack screw is provided a pin-on end pad. When both the components of the stabilizers are fully extended and end pads in position, ground contact will not occur (level surface) until "A" frame load depresses rear springs approximately two (2) inches. This feature allows a partial distribution of the load to springs, tires and rear axle. A slight loading of the rear tires inhibits lateral movement of the vehicle in the event of load shifting. Both the telescoping legs and jack screws incorporate "stops" for the fully extended position; indexing drill holes enable the operator quickly "pin" for down operations.

VEHICLE CHASSIS SPECIFICATION

Intent: Specification will describe a cab-over engine truck chassis, without body. Cab and chassis shall be suitable for heavy rescue/fire vehicle service when buildup phase is completed by the purchaser.

General:

- Vehicle to be latest production model
 - Vehicle shall be FOB Sacramento, California
 - Vehicle will be completely assembled and ready to operate (as a cab and chassis) when delivered.
1. WHEEL BASE: 175 inches*
*This shall be modified by the purchaser.
 2. CAB AXLE: 139.9 inches*
*This shall be modified by the purchaser.
 3. ENGINE: Shall be diesel, "V" block style, (8) cylinders, (4) stroke cycle, 636 cubic inch displacement, 200 gross horsepower, 188 net horsepower at 2800 rpm, 490 pounds feet torque at 1400 rpm.

The engine described above shall have the following features or meet the following standards:

- Exhaust system - One horizontal muffler and one horizontal tail pipe.
- Back pressure - Exhaust back pressure shall not exceed the limits specified by the engine manufacturer.
- Noise level - Shall not exceed California State or Federal regulations.
- Emissions - Exhaust emission shall not exceed California State or Federal regulations.
- Oil Filter System - OEM standard for severe service application.
- Fuel filter system - OEM standard for severe service application.
- Air Cleaner - Dual element, dry type.
- Oil Cooler - OEM standard.
- Governor - OEM standard.

4. ENGINE COOLING SYSTEM: Radiator, maximum capacity available from chassis OEM. Fan, OEM standard, based on engine application.

5. ELECTRICAL EQUIPMENT:

- Alternator, 130 amp, two belt driven.
- Starter, 12 volt, OEM standard for engine application.
- Battery - (1) BCI Group 8D8, 12 volt, 200 ampere hour rating.
- Volt Meter, (battery indicator) dashboard mounted.
- Ammeter, dashboard mounted, scaled for alternator application.

6. FRONT AXLE: OEM rating of not less than 12,000 pounds.

6A. FRONT AXLE, STEERABLE DRIVE (OPTIONAL):

Maximum capacity 16,000 pounds.

Make: Kelsey-Hayes, Fabco Division.

Model: SDA-16.

Features:

- Housing - fabricated, cast steel banjo, steel tubes and flanges.
- Spring Centers - minimum 30 inches.
- Camber - adjustable
- Wheel Provisions - 10 studs on $11\frac{1}{4}$ " circle, minimum wheel size 20 inch.
- Ratio - 5.57
- Turn Angle - 35°
- Brakes - Drum type, air actuated wedge 15 inch diameter x 5 inches. Must comply with all applicable FMVSS in effect.

NOTE: This optional feature requires certain chassis modifications and additional equipment. Details are as follows:

Cut and step chassis main frame. In general, this operation will require fishplating the vehicle frame at the step point. Repositioning of one frame crossmember. Relocating muffler and additional header pipe length. A reduction of 18 inches in wheel base will occur when frame is cut and stepped. Head lights will not be positioned

at legal height (CVC) and will require modification; i.e., lower to legal height (not lower than 24" at center or higher than 52" at center, measured from the surface the vehicle rests upon).

6B. TRANSFER CASE: Two speed, rated as follows -

- Torque input - 3300 lbs. ft. maximum
- Input Horsepower - 250 hp maximum
- Input Speed - 3800 maximum
- Make: Kelsey-Hayes, Fabco Division
- Model - TC-33
- Ratios: Direct 1:1
Underdrive 2.22:1

General, 6A, 6B

All proposals for steerable front drive axle application shall be a complete "furnish and install" package. Further, all proposals shall be supported by valid engineering details; i.e., drawings, specifications and all OEM literature available. Completion time must be stated.

Note: Chassis specification shall provide compatible steering components and rear axle ratio for 16,000# front axle option.

7. TRANSMISSION: Manual shift, 5 speeds forward, synchromesh, for use with (2) speed axle application.

Make - Clark. Model - 397V.

Note: SAE PTO openings shall be provided, left and right side.

8. CLUTCH: Shall be 14 inch, two plate, OEM heavy duty.

9. REAR AXLE: Single reduction, with electric-operated two speed feature.

Make - Eaton. Model - 18221.

Rated Capacity - not less than 22,000 lbs.

Ratios - 5.57/7.60.

10. BRAKES: Shall be straight air design ("S" cam brakes on front and rear axles). The emergency stopping system shall comply with California State and Federal regulations.

Note: OEM shall supply the largest brakes available to axles specified. The following items shall be furnished and installed:

- Air pressure gauge(s) - shall be dashboard mounted and visible to the operator.
- Audible alarm - shall indicate low air pressure.
- Air Compressor - 12 cu. ft. minimum.

The complete brake system must comply with all California State & Federal Regulations that apply.

11. STEERING GEAR:

OEM Standard with power assist feature.

Rating: Not less than 16,000 lbs. as it applies to related components.

12. FRAME:

Shall be double channel reinforced. Section modulus not less than 21.75, PSI 36,000.

13. SPRINGS:

Shall have total capacity equal to and consistent with the maximum ratings of the axles. In addition, the rear springs shall be equipped with auxiliary springs for severe service off road.

14. WHEELS:

Six ventilated disc wheels (steel).

Wheel Size: 20 inch

Rim: 8.0 inch

Hole: 10

Bolt Circle: 11.25 inch

Note: No spare

15. TIRES:

Six (6) each 11.00 x 20, 14 ply tube-type tires, mounted.

16. FUEL TANK:

Fifty gallon steel "D" tank, frame mounted, passenger's side.

17. WINDSHIELD WIPERS:

Dual, OEM standard, air powered. Dual dashboard controls shall be provided. OEM standard windshield washers shall be provided.

18. CAB:

COE type, all steel construction. Cab shall tilt forward when unlocked and in the raised position.

- Seat - full width, 3-passenger. Seat cover shall be heavy weight black vinyl.
- Seat Belts - Three sets shall be furnished and installed.

19. PAINT: Cab, OEM standard white; undercarriage black.

20. MISCELLANEOUS EQUIPMENT AND ACCESSORIES:

The following shall be furnished and installed:

- Engine tachometer
- Dual sun visors
- Truck-type mirrors, right and left sides. Size not less than 16" x 7".
- Fresh air heater and defroster
- Ash tray
- Locking-type hand throttle control
- Temperature gauge
- Fuel gauge
- Oil pressure gauge
- Warning lights with buzzer for low oil pressure and high water temperature.
- Door locks each side

21. LEGAL: Equipment and accessories shall conform to the provisions of the California Vehicle Code and (if applicable) to the Safety Orders of the Division of Industrial Safety. In addition, the equipment on the vehicle shall conform to California State and Federal Safety Regulations.

22. GENERAL PROVISIONS:

- The component parts of the vehicle shall be of proper design and capacity to safely withstand maximum stresses imposed when the vehicle is loaded to the manufacturers GVW rating and operating under maximum power developed by the engine.
 - Any and all equipment cataloged as standard shall be furnished and included in the purchase price of the vehicle.
 - Vehicle pre-delivery service shall be performed prior to delivery to the purchaser.
 - Operator's manual for engine and chassis shall be furnished.
23. WARRANTY: Shall extend and provide full manufacturer's coverage as of the "in-service date" of the vehicle. In-service date is the first day the completed vehicle is assigned as an in-service rescue/fire vehicle. Manufacturer shall provide the necessary forms for implementing the delayed start warranty.
24. Original "Dealer's Report of Sale" shall be delivered promptly to the purchaser at the time of delivery of vehicle or vehicles covered by these specifications.

F I E L D T E S T R E S U L T S

GENERAL

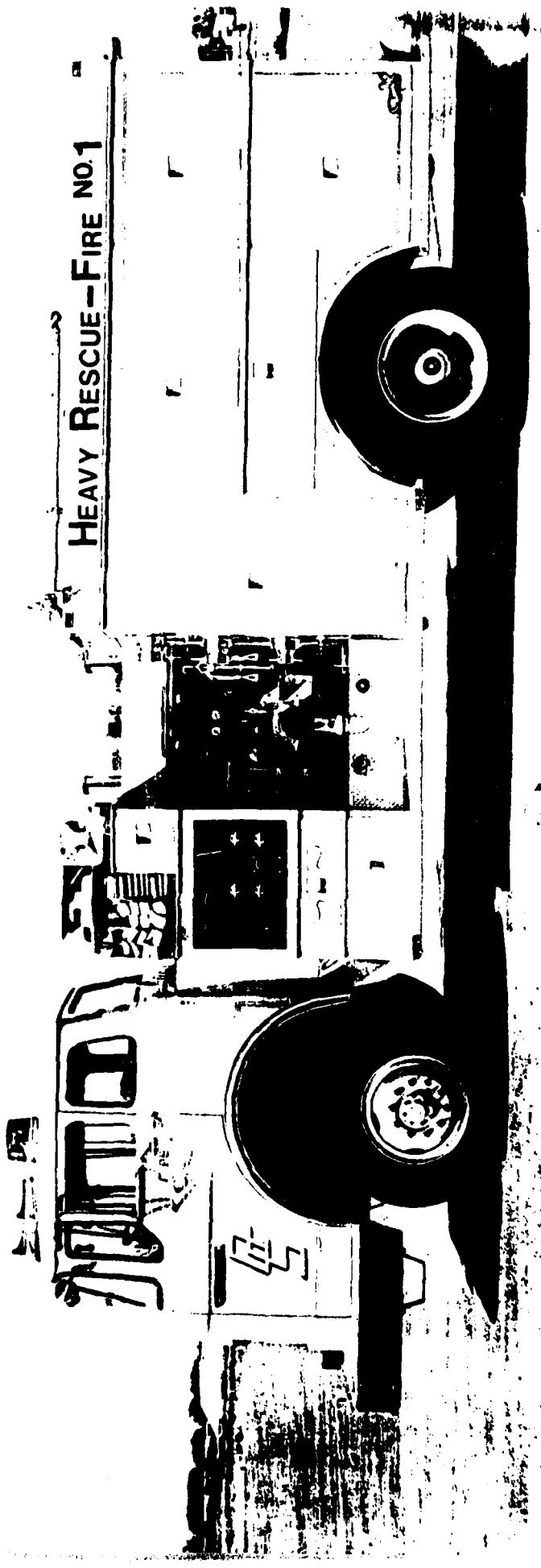
The majority of field testing of the heavy rescue/fire vehicle prototype was accomplished through integration with the heavy rescue training phase of the contract. To date, the heavy rescue/fire vehicle prototype meets or exceeds recognized standards in all of the areas tested.

Areas or systems tested include the following:

- Removable equipment payload.
- Fixed position payload.
- Steering
- Stopping Distance
- Fire Pump
- All-wheel-drive feature.
- Front winch
- Rear winch
- "A" Frame
- Lifting device, front winch
- Balance; i.e., weight distribution between front and rear axles.
- Excess power

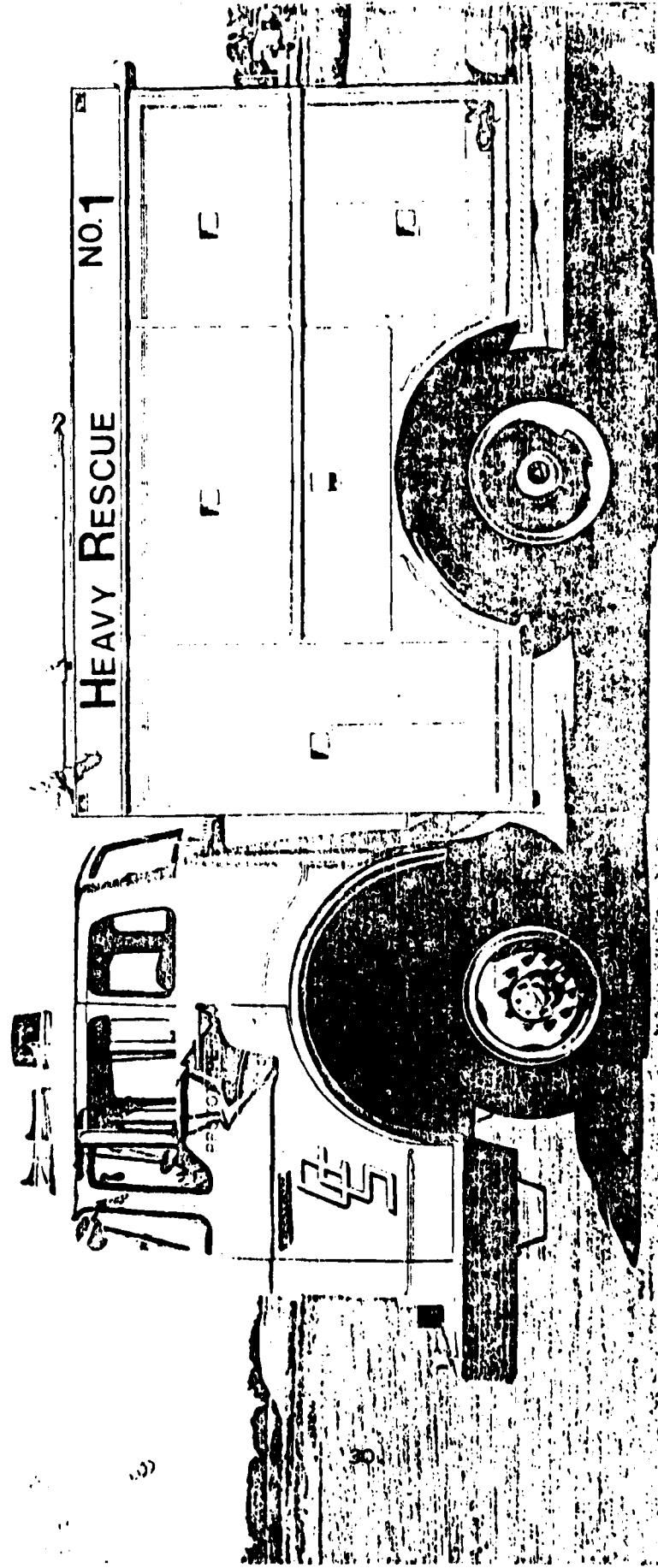
HEAVY RESCUE-FIRE VEHICLE (ACTUAL)
WITH ALL OPTIONS

HEAVY RESCUE-FIRE NO. 1



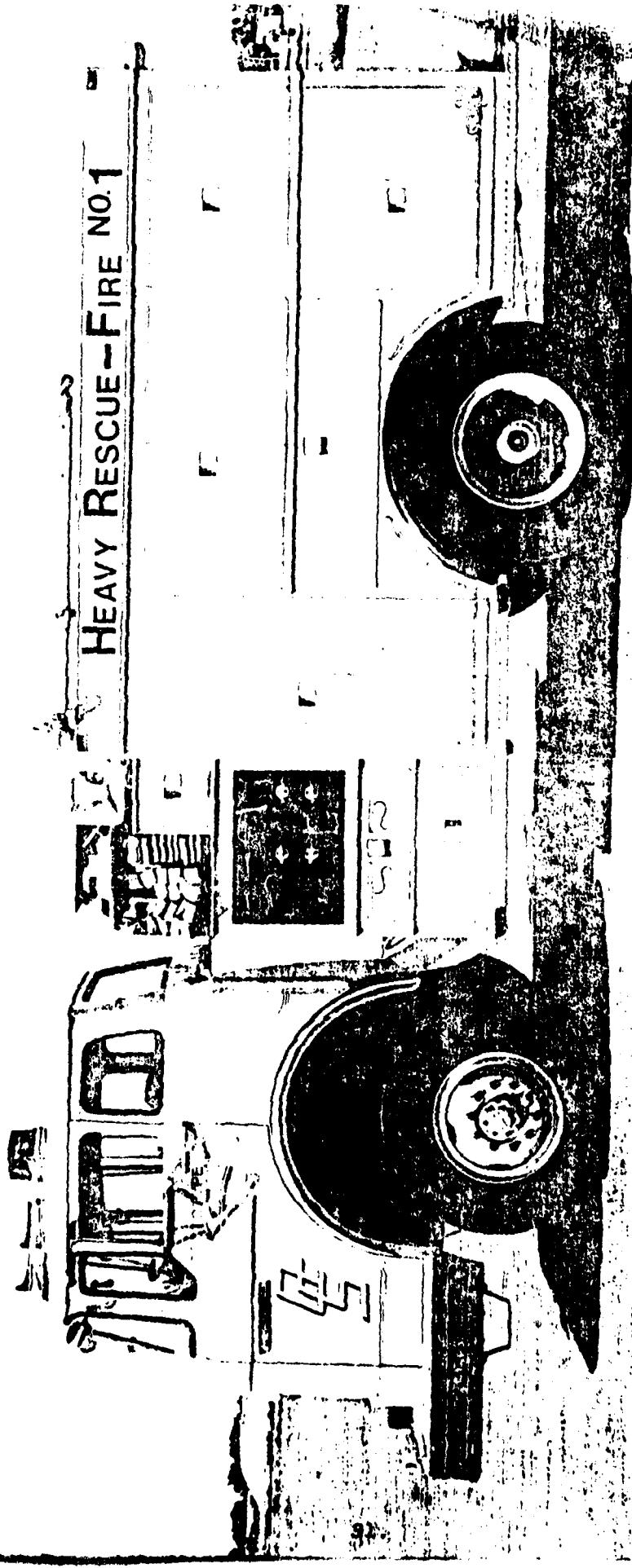
HEAVY RESCUE-FIRE VEHICLE

SHORT WHEEL BASE (SUPERIMPOSED)



HEAVY RESCUE-FIRE VEHICLE

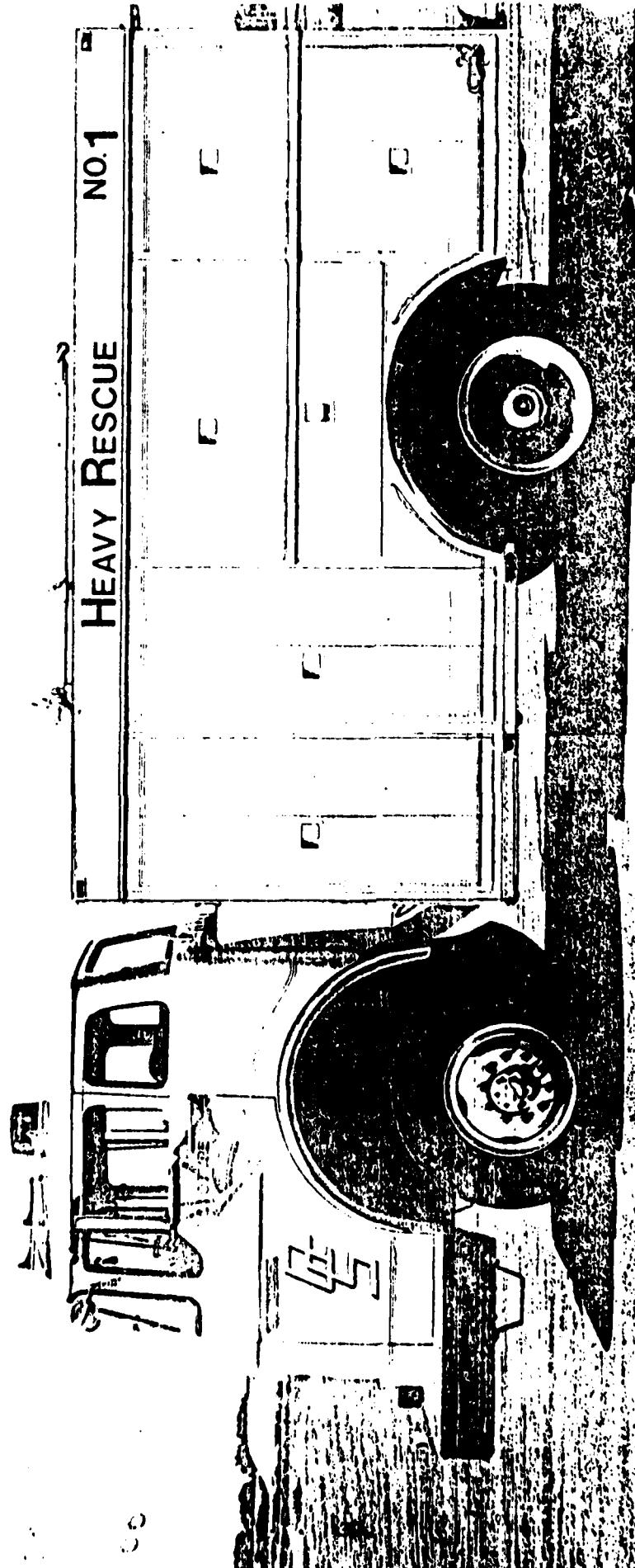
MID-SHIP FIRE PUMP, SHORT WHEEL BASE (SUPERIMPOSED)



HEAVY RESCUE - FIRE NO. 1

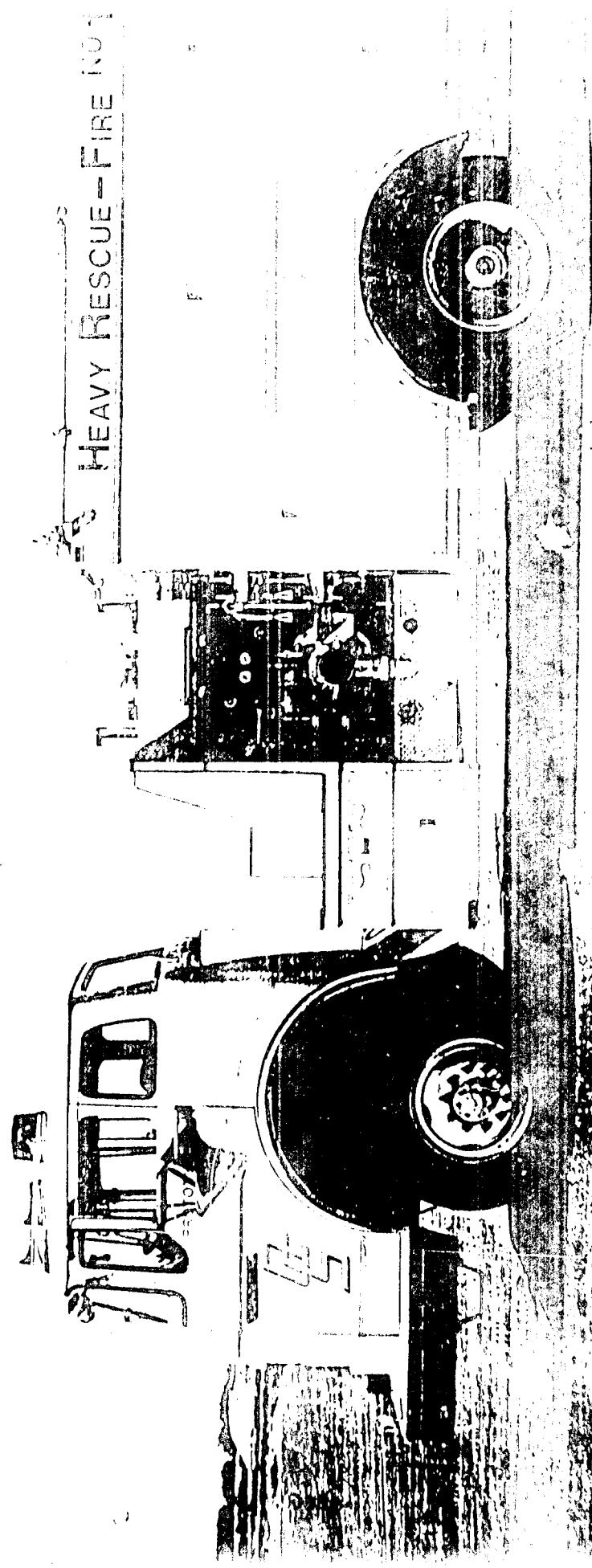
HEAVY RESCUE-FIRE VEHICLE

LONG WHEEL BASE (SUPERIMPOSED)



HEAVY RESCUE-FIRE VEHICLE

CREW SEAT, SKID-MOUNTED PUMP (SUPERIMPOSED)



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